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## (54) Method of manufacturing a jet nozzle plate for an ink-jet printing head

(57) A plate 1 of chemically etchable material is first provided with a bore 2 for each nozzle, the bore having a diameter larger than the desired internal diameter of the ultimate jet nozzle. Recesses 4 are then formed and then the whole of the plate including the wall of each bore is covered with a layer 7 of chemically

deposited etch-resistant material. Subsequently the etch-resistant layer on the raised portion of the plate around each bore 2 is removed by grinding the front side of the plate down to the level, (see dotted line) of the etch-resistant layer 7 in the recesses 4. The material of the plate exposed by the grinding is then removed by etching to leave the etch-resistant layer 7 on the wall of each bore 2 projecting as a cylindrical tube 8 from the front side of the plate to form a jet nozzle.

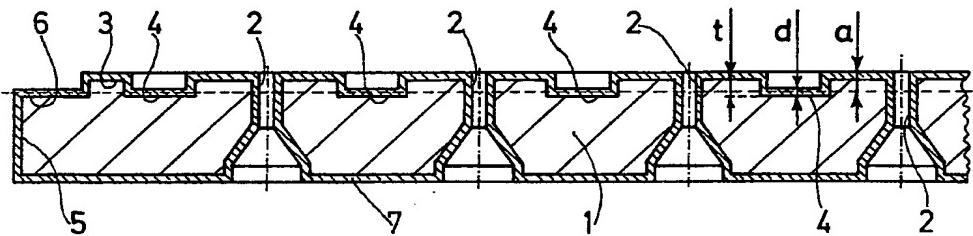


Fig.4

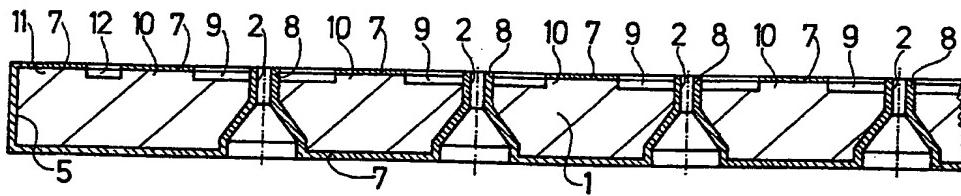
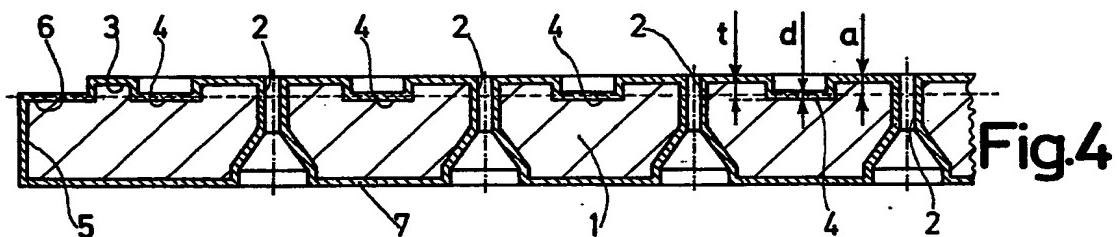
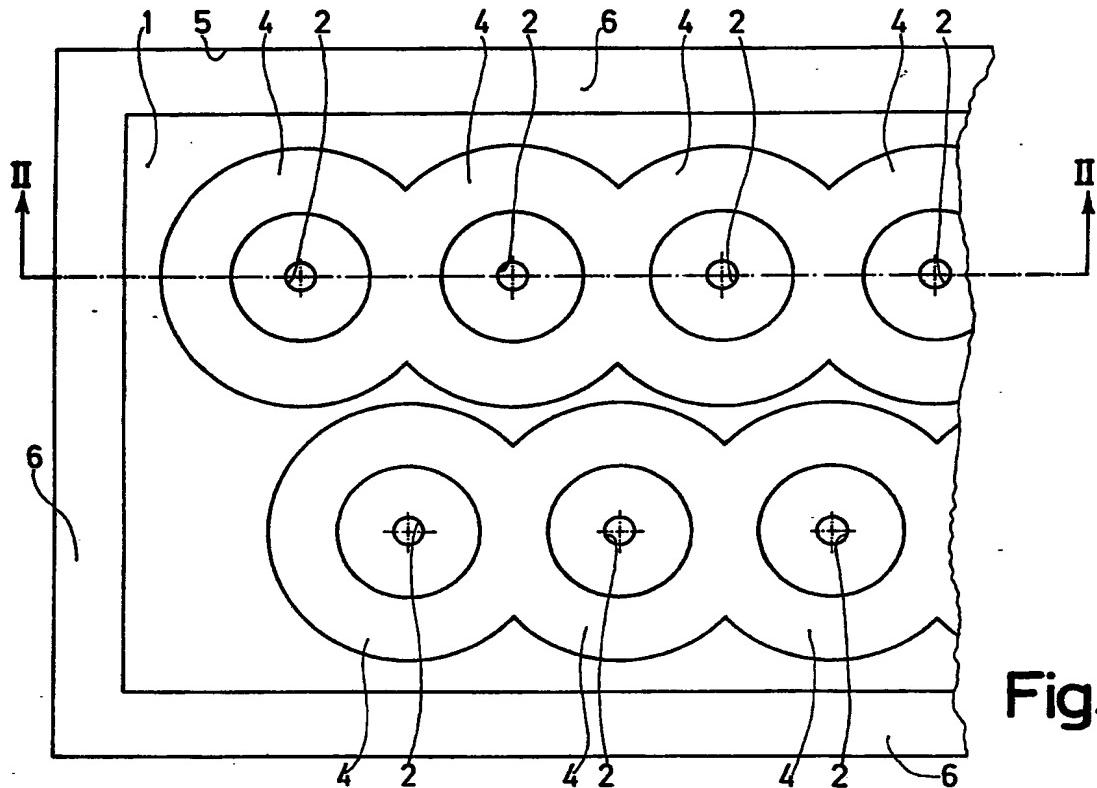
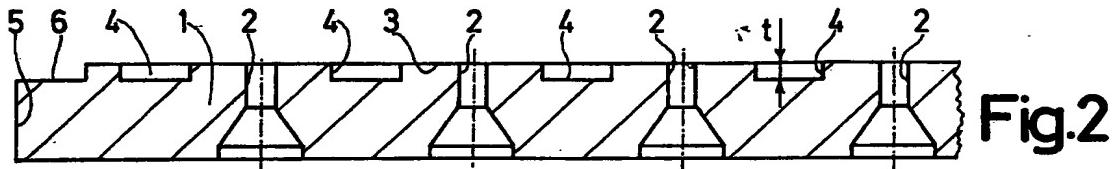
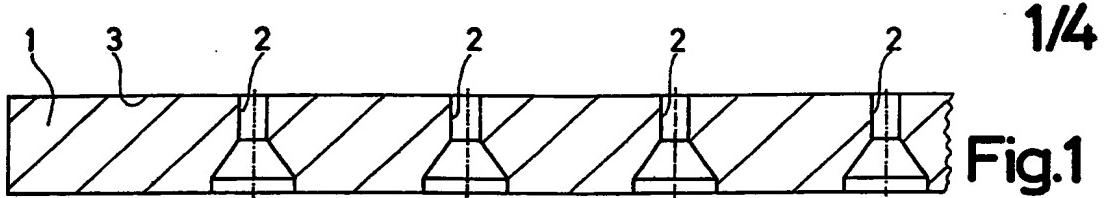


Fig.6

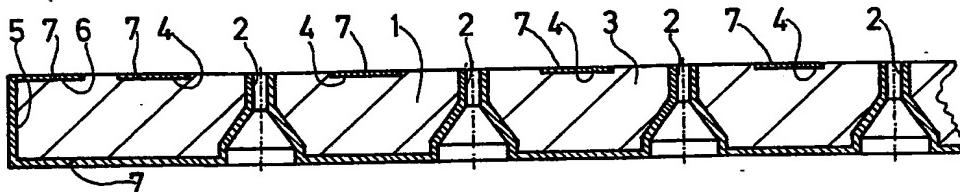
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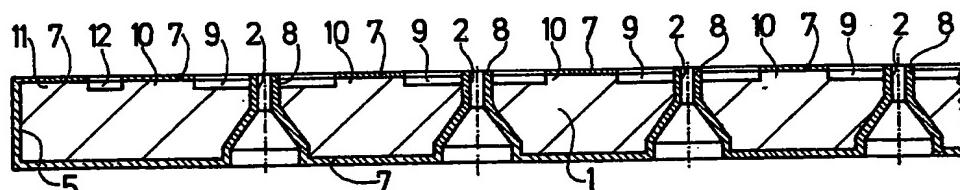


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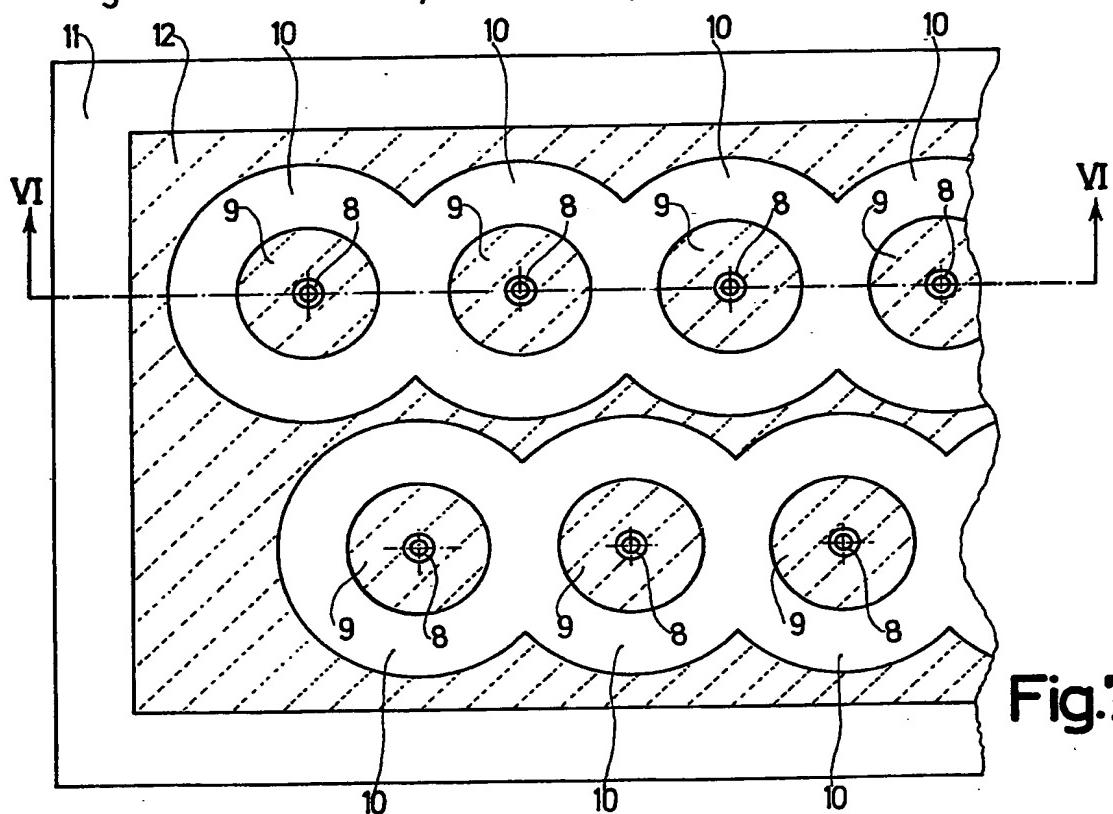
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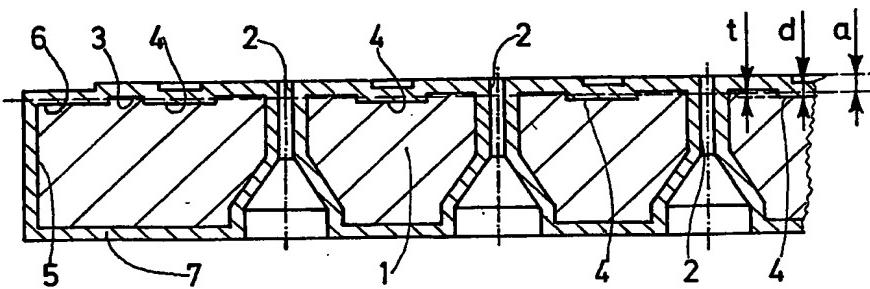
**Fig.5**



**Fig.6**



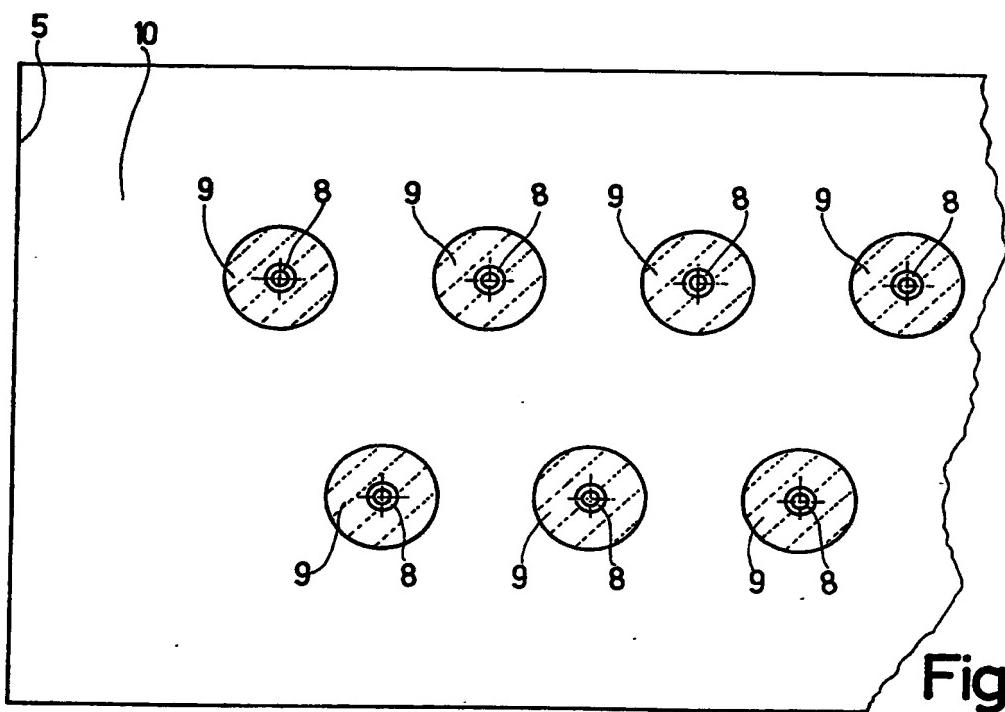
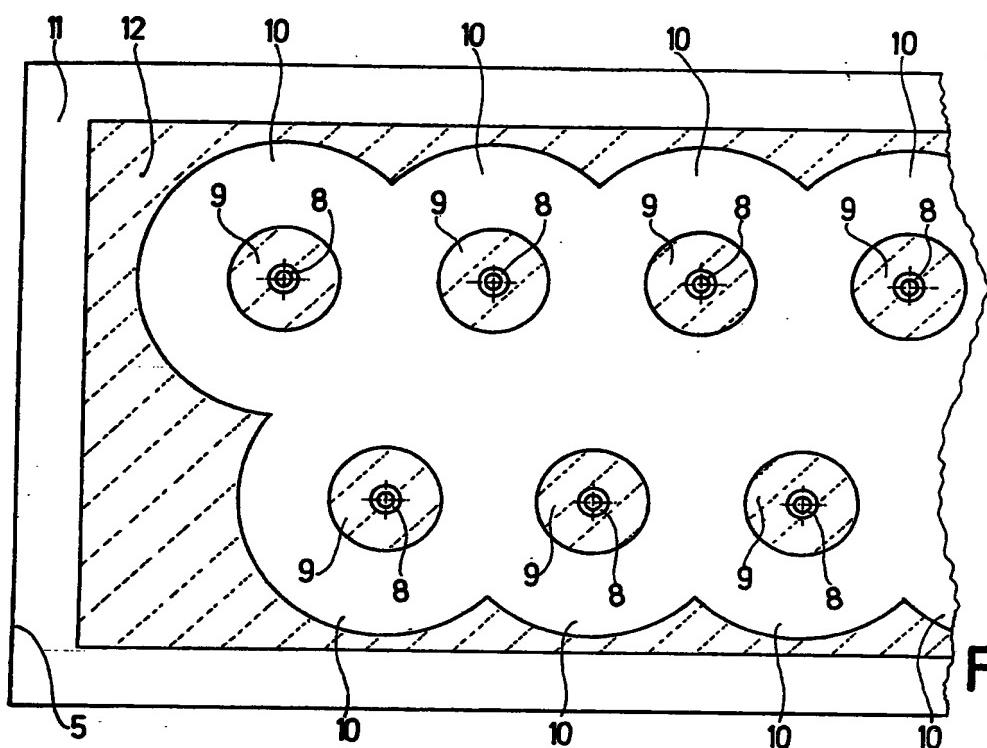
**Fig.7**

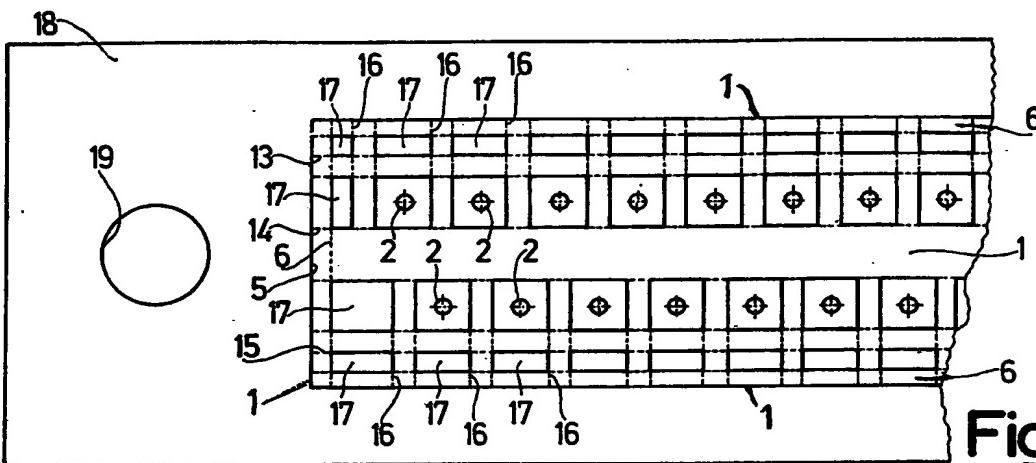
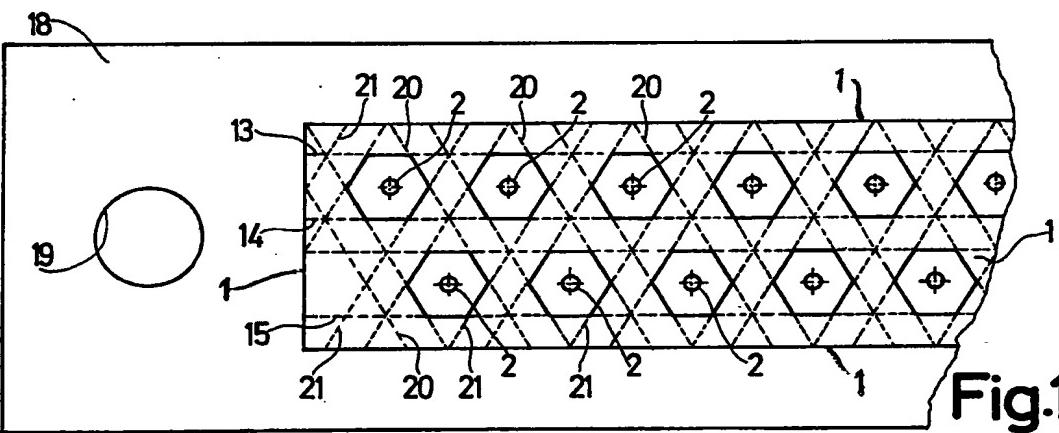


**Fig.8**

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**Fig.11****Fig.12**

**SPECIFICATION****Method of manufacturing a jet nozzle plate for an ink-jet printing head**

- The invention relates to a method of  
 5 manufacturing a jet nozzle plate for an ink-jet  
 printing head, which plate comprises a jet nozzle  
 having a given internal diameter.
- IBM Technical Disclosure Bulletin, Vol. 15,  
 No. 9, pages 2845 and 2846, discloses a method  
 10 of manufacturing such a jet nozzle plate, in which  
 a base plate from which the jet nozzle plate is to  
 be formed and which is made of a chemically  
 etchable material is first provided with a bore  
 15 having a diameter larger than the desired internal  
 diameter of the ultimate jet nozzle, and a wire is  
 concentrically inserted in the bore, the diameter of  
 said wire corresponding to the desired internal  
 diameter of the ultimate jet nozzle, after which the  
 20 whole of the base plate including the wall of the  
 bore is covered with a layer of etch-resistant  
 material which is chemically deposited on the  
 plate. The wire is then removed by etching so that  
 the jet nozzle is freed. A given length of the wire  
 25 projects from the bore, so that etch-resistant  
 material is also deposited on this projecting part of  
 the wire and a jet nozzle is formed which consists  
 of a tube whose free end projects from the jet  
 nozzle plate. A method of this kind is not easy to  
 30 perform, particularly in view of the centering of the  
 wire in the bore.

For the manufacture of a jet nozzle plate in  
 which a jet nozzle is formed by a tube whose free  
 end projects from the jet nozzle plate, it may be  
 stated that even though favourable properties are  
 35 thus obtained as regards the ejection of droplets  
 of ink from such a jet nozzle plate, it is difficult to  
 cap the jet nozzle exactly with a capping device  
 when the jet nozzle is not in use, for example, in  
 the rest condition of the ink-jet printing head, in  
 40 order to prevent drying of the ink in the jet nozzle  
 and hence clogging of the nozzle so that it can no  
 longer be used. This difficulty arises *inter alia*  
 because the capping device, customarily  
 consisting of a slightly elastic cushion, is not  
 45 arranged exactly flat against the end face of the  
 tube but is curved over this end, so that it does not  
 completely cover the jet nozzle. In this respect  
 German Auslegeschrift 23 62 576 has already  
 proposed an embodiment of the jet nozzle plate in  
 50 which an annular trough is provided around a jet  
 nozzle, said trough being adjoined by a land  
 having a plane surface which is situated at the  
 same level as the end face of the jet nozzle, which  
 itself is also tubular. However, said German  
 55 Auslegeschrift 23 63 576 does not describe how  
 such a jet nozzle plate can be efficiently  
 manufactured.

According to the present invention there is  
 provided a method of manufacturing a jet nozzle  
 60 plate for an ink-jet printing head, which plate  
 comprises a jet nozzle having a given internal  
 diameter, wherein a base plate from which the jet  
 nozzle plate is to be formed and which is made of a  
 chemically etchable material is first provided

- 65 with a bore which extends through the base plate  
 and of which at least a portion that opens out of  
 one side of the plate is cylindrical and has a  
 diameter larger than the desired internal diameter  
 of the ultimate jet nozzle, material is then removed  
 70 from said one side of the base plate by milling so  
 as to leave on said side of the base plate a portion  
 which adjacently surround the bore and is raised  
 with respect to the adjoining portion of said side  
 of the base plate, the whole of the base plate  
 75 including the wall of the bore is subsequently  
 covered with a layer of etch-resistant material  
 which is chemically deposited on the plate to a  
 thickness equal to half the difference between the  
 diameter of said cylindrical portion of the bore and  
 80 the desired internal diameter of the ultimate jet  
 nozzle, after which the etch-resistant layer is  
 removed from at least the top of the raised portion  
 on said one side of the base plate by grinding in a  
 plane perpendicular to the axis of the bore to a  
 85 depth which at least equals the thickness of said  
 layer but which is smaller than the sum of the  
 thickness of the layer and the depth to which  
 material was removed from said one side of the  
 base plate by milling, and finally material of the  
 90 base plate surrounding the bore and exposed by  
 the grinding is removed by etching to leave the  
 etch-resistant material which was deposited on  
 the wall of said cylindrical portion of the bore  
 projecting as a cylindrical tube from said one side  
 95 of the base plate to form the jet nozzle, the tube  
 being surrounded by a trough formed in said one  
 side of the base plate by the etching.  
 Preferably, the grinding is continued until the  
 100 etch-resistant layer on that part of said one side of  
 the base plate from which material was removed  
 by milling has been partially ground down. This  
 part of the base plate, with the etch-resistant layer  
 thereon, is then left by the subsequent etching  
 105 process as a land on said one side of the base  
 plate, the top surface of the land lying in the same  
 plane as the end face of the tube forming the jet  
 nozzle. The top surface of the land consequently  
 provides an accurate supporting surface for a  
 110 capping device for the jet nozzle plate.  
 The removal of material from said one side of  
 the base plate by milling may form an annular  
 recess in said side of the plate, which recess  
 surrounds and is spaced from the bore in the base  
 115 plate. The recess can be formed simply and  
 accurately by means of an end-milling cutter.  
 Alternatively, the removal of material from said  
 one side of the base plate by milling may be  
 effected by milling straight grooves in said side of  
 120 the plate, the grooves intersecting one another so  
 as to form around the bore in the base plate and  
 spaced therefrom a recess in the form of a channel  
 of polygonal shape in said side of the base plate.  
 The grooves may be formed by means of a side-  
 125 milling cutter.  
 Material may be removed from said one side of  
 the base plate by milling to a depth which is  
 smaller than the thickness of the etch-resistant  
 layer subsequently deposited thereon. Because  
 the amount by which this side of the base plate is

subsequently ground down must be at least equal to the thickness of the layer but smaller than the sum of the thickness of this layer and the depth of which material was removed from said side of the

- 5 base plate by milling, grinding may be comparatively critical if the milling depth is small. Preferably, therefore, the removal of material from said one side of the base plate by milling is carried out to a depth which is greater than the thickness
- 10 of the etch-resistant layer subsequently deposited on the base plate, the subsequent grinding being continued until the etch-resistant layer on that part of said one side of the base plate from which material was removed by milling has been partially
- 15 ground down. The amount of grinding is thus greater, so that the grinding operation can be better controlled.

In those embodiments in which the removal of material from said one side of the base plate by milling leaves in this side of the plate a recess surrounding and spaced from the bore in the plate, a rebate may be milled in said one side of the base plate around the edge thereof prior to the deposition of the layer of etch-resistant material,

- 20 25 the rebate having the same depth as the recess surrounding the bore in the base plate. This rebate results in the production of an additional land on the base plate to provide a further supporting surface for a capping device.
- 30 For manufacturing a jet nozzle plate having a plurality of jet nozzles the base plate may be formed with a corresponding plurality of said bores, and around each bore at a distance therefrom a recess may be milled in said one side

- 35 of the base plate so as to leave on this side of the plate a raised portion adjacently surrounding the respective bore, the recess being formed so as to merge with one another. This results in the formation of a continuous land on the base plate
- 40 to provide a continuous supporting surface for a capping device.

To obtain the maximum supporting surface for a capping device, material may be removed by milling from the whole of said one side of the base plate except for the portion surrounding the bore.

Some embodiments of the invention will now be described in detail with reference to the accompanying drawings, in which:

- 50 Fig. 1 is a sectional view of a part of a base plate formed with a plurality of bores for jet nozzles,

Fig. 2 is a sectional view taken on the line II—II in Fig. 3, showing the base plate of Fig. 1 formed with recesses around the bores,

- 55 Fig. 3 is a front elevation of part of the base plate of Fig. 2,

Fig. 4 is a sectional view showing the base plate of Fig. 2 after the deposition of the etch-resistant layer,

- 60 Fig. 5 is a sectional view showing the base plate of Fig. 4 after the grinding of the front side thereof,

Fig. 6 is a sectional view taken on the line VI—VI in Fig. 7, showing the base plate of Fig. 5 after the etching which produces the finished jet

nozzle plate,

Fig. 7 is a front elevation of the jet nozzle plate shown in Fig. 6,

- 70 Fig. 8 is a view similar to Fig. 4, showing a base plate formed with recesses whose depth is smaller than the thickness of the etch-resistant layer,

Fig. 9 is a front elevation of part of a finished jet nozzle plate in which the lands surrounding the troughs around the jet nozzles all merge with one another to form a continuous surface for supporting a capping device.

- 80 Fig. 10 is a view similar to Fig. 9, showing a finished jet nozzle plate in which one continuous land surrounding the troughs around the jet nozzles extends as far as the edges of the plate,

Fig. 11 is a view similar to Fig. 3, showing a base plate in which recesses in the form of channels of rectangular shape are formed around the bores in the plate by milling a pattern of straight intersecting grooves in the front side of the base plate, and

- 85 Fig. 12 is a view similar to Fig. 11, showing a base plate in which a pattern of straight intersecting grooves is milled in the front side of the base plate such as to leave raised portions of hexagonal shape surrounding the bores in the plate.

The principle of the method of manufacturing a jet nozzle plate in accordance with the invention will be described in detail hereinafter with reference to Figs. 1 to 7. Fig. 1 shows part of a base plate 1 for a jet nozzle plate, which base plate consists of a chemically etchable material, preferably brass. For this embodiment it is

- 95 assumed that the jet nozzle plate is to comprise two parallel rows of jet nozzles, the jet nozzles in one row being staggered with respect to the jet nozzles in the other row and each row comprising, for example, twelve jet nozzles. Obviously, it is alternatively possible to provide more than two rows of jet nozzles or only one row of jet nozzles,

and the number of jet nozzles may also be different, even to the extent of having a single jet nozzle. This is completely dependent on how the characters are formed by means of the ink-jet printing head for which the jet nozzle plate is intended. To form the individual jet nozzles, the base plate 1 is first provided with bores 2 which

- 100 are cylindrical at the front 3 of the base plate, widen in a conical manner towards the rear of the plate and finally become cylindrical again. It has been found that such a shape, which is known *per se*, is advantageous with respect to the ultimate configuration of the ink-jet nozzles and

the connection of the ink supply ducts to the individual jet nozzles of the jet nozzle plate (which is irrelevant to the invention). However, it is also possible to give the bores 2 a wholly cylindrical shape. The diameter of the bores 2 is larger than the internal diameter of the ultimate jet nozzle. This offers the advantage that it simplifies the formation of the bores 2 since the internal diameter of a finished jet nozzle is usually very small, for example, of the order of 0.05 mm.

- 110 120 125 130 The next step in the manufacture of the jet

nozzle plate is the milling of a recess 4 around each bore 2 in the front side 3 of the base plate 1, the recess being concentric with and spaced from the bore, as shown in Figs. 2 and 3. The recesses 5 4 in this embodiment are of annular shape and can be very accurately formed by means of an end-milling cutter. The inner and outer diameters of the recesses in this embodiment are so chosen that adjacent recesses in each row merge and 10 open into one another. It is alternatively possible to give the recesses diameters such that adjacent recesses do not open into one another, each bore 2 then being surrounded by a recess which has the shape of a closed circular ring. It has been 15 found that the inner diameter of the recesses should preferably amount to eight times the internal diameter of the ultimate jet nozzles to ensure sufficient freedom around the tubes which, as will be described later herein, form the finished 20 jet nozzles. The outer diameter of the recesses is dependent on the distance between adjacent bores or finished jet nozzles, which distance may be of the order of, for example, 0.5 mm. The depth  $t$  of the recesses 4 may be of the order of 25 0.04 mm when the other dimensions have the values given above. It has also been found that for reasons which will be explained later herein, a rebate 6 should preferably be milled in the front side of the base plate around the edge thereof to the same depth as the recesses 4 surrounding the bores 2.

The whole of the base plate 1, including the walls of the bores 2, is subsequently covered with a layer 7 of an etch-resistant material of a kind 35 which can be deposited on the plate 1 by a chemical process, for example, nickel. The choice of the thickness  $d$  of this layer is governed by the fact that the internal diameter of the ultimate jet nozzles will be determined by the thickness of this 40 layer. The thickness of the layer is consequently made equal to half the difference between the diameter of the front cylindrical portions of the bores 2 and the desired internal diameter of the ultimate jet nozzle. A value of approximately 45 0.03 mm may be chosen for the thickness of the layer 7. The base plate 1 is now in the condition shown in Fig. 4. As can be readily seen, the depth  $t$  of the recesses 4 in this embodiment is chosen so that it exceeds the thickness  $d$  of the layer 7. 50 In the next step, the front 3 of the base plate 1 is ground down by an amount  $a$  which at least equals the thickness  $d$  of the layer 7 but which is smaller than the sum of the thickness  $d$  of the layer 7 and the depth  $t$  of the recesses 4. In this 55 embodiment, this amount  $a$  is so chosen within the said limits that during the grinding down of the front of the base plate, the portions of the layer 7 that cover the bottoms of the recesses 4 and the rebate 6 are also slightly ground down as shown 60 in Figs. 4 and 5. Thus, around each bore, and between the recesses 4 and the rebate 6, material of the base plate 1 is exposed, the originally continuous layer 7 of etch-resistant material thus being divided into separate layers 7. Because 65 grinding is continued until the layers on the

bottoms of the recesses 4 and the rebate 6 are also ground down slightly, it is ensured that there are no raised edges on these layers, so that the front of the base plate forms a completely flat 70 surface.

Finally, at the front of the base plate 1, exposed material of the plate is removed by etching, leaving the etch-resistant material of the remaining layers 7 intact. This leaves the layers 7 5 in the bores 2 projecting from the base plate 1 as free cylindrical tubes 8, each of which forms a jet nozzle, as shown in Figs. 6 and 7. As a result of the removal of material of the base plate 1 around each of the tubes 8, each of these tubes is 80 surrounded by an annular trough 9 which is in turn surrounded by a land 10 having a plane surface which has not been affected by the etching operation since it is formed by a layer 7 of etch-resistant material. Accordingly, each land 10 85 consists of the material of the base plate at its base and of the material of the layer 7 at its top. The outer diameter of the troughs 9 corresponds to the inner diameter of the recesses 4. A land 11 also extends around the edge 5 of the base plate 90 on the front side thereof as a result of the etching away of material of the plate between the layers 7 of etch-resistant material on the bottoms of the recesses 4 and the layer on the bottom of the rebate 6. Thus, a trough 12 is formed in the front 95 side of the base plate between the lands 10 and the land 11. This trough and the troughs 9 around the tubes 8 are shown shaded in Fig. 7. Because the flat surfaces of the lands 10 and 11 and the end faces of the tubes 8 forming the jet nozzles 100 are all formed by the one grinding operation, they are all situated in one plane perpendicular to the axes of the jet nozzles.

As can be seen, a jet nozzle plate manufactured by the above method offers the desired 105 advantages, namely, on the one hand the individual jet nozzles consist of free cylindrical tubes which are very effective for the ejection of ink droplets whilst on the other hand the troughs 9 which provide the free space around the individual 110 jet nozzles are surrounded by lands 10 having flat surfaces which are situated in the same plane as the end surfaces of the tubes 8 forming the jet nozzles, so that these lands 10 can be used as supporting surfaces for a capping device when the 115 jet nozzle plate is capped by means of such a device in order to prevent drying of the ink present in the jet nozzles and hence clogging of the jet nozzles. Moreover, the lands 10, being situated at a distance from the tubes 8, also after protection 120 against damage to these comparatively vulnerable tubes.

In the above embodiment, as can be seen in Figure the layers 7 of the lands 10 which surround the jet nozzles 8 form a continuous surface along 125 each row of nozzles. This is due to the fact that the relevant recesses 4 in which these layers were formed open into one another. It has been found that such a formation of the layers 7 is very advantageous since it assists uniform capping of the jet nozzles. As has already been suggested,

- however, it is alternatively possible for the recesses 4 to be completely separate from one another. In that case each jet nozzle 8 is surrounded by a separate layer 7, which may be found sufficient for efficient capping of the jet nozzles.
- With reference to Fig. 4 it has already been stated that the depth  $t$  of the recesses 4 is preferably chosen to be larger than the thickness  $d$  of the subsequently deposited layer 7. The same result as regards the ultimate form of the jet nozzle plate, however, can also be obtained by making the depth  $t$  smaller than the thickness  $d$ , as shown in Fig. 8. In that case the front of the base plate must be ground down by an amount  $a$  which is again equal to or larger than the thickness  $d$  but smaller than the sum of the thickness  $d$  and the depth  $t$ . Because the depth  $t$  itself is now smaller the grinding may be more critical in this case but less material of the base plate has to be removed, which may also be advantageous in given circumstances. The etching of such a base plate after the grinding has been completed is effected in exactly the same way as in the first embodiment.
- In the embodiment shown in Fig. 9 the layers 7 of the lands 10 which surround the jet nozzles 8 form a continuous surface which extends both along each row of nozzles and from row to row.
- This provides an even better supporting surface for a capping device. To produce this surface the recesses 4 in which the relevant layers 7 are formed are constructed to merge with one another both between the bores 2 in each row of bores and between the rows of bores. A similar result could be obtained by providing a further recess between the two rows of bores 2 in the embodiment described with reference to the Figs. 1 to 7, said further recess connecting the recesses 4 surrounding the bores of one row with the recesses 4 surrounding the bores of the other row.
- In the embodiment shown in Fig. 10, a maximum supporting surface for a capping device is obtained. In this embodiment the jet nozzles are surrounded by one continuous land 10 which extends to the edge 5 of the base plate and which forms one continuous surface on the front side of the plate for supporting a capping device. This continuous land is obtained by removing material of the base plate, by further milling, from the whole of the front side of the plate to the same depth as that of the recesses 4, leaving only an annular raised portion around each of the bores 2. The subsequent application of a layer of etch-resistant material to the plate and the grinding and etching processes are carried out in the same way as described above. It has been found that such a jet nozzle plate offers very good results in practice.
- In the embodiment of Fig. 11, the base plate 1 is provided with recesses by milling straight grooves in the front side of the plate, the grooves intersecting one another so as to form around each bore 2 a recess in the form of a channel of polygonal shape, in this case rectangular, which channel is spaced from the respective bore to

- leave a raised portion of corresponding polygonal shape on the front surface of the base plate surrounding the bore. In Fig. 11 there are three grooves 13, 14 and 15 extending parallel to the two rows of bores 2, the grooves 13 and 15 being located outside the rows of bores and the groove 14 between the rows, and a plurality of grooves 16 extending at right angles to the rows of bores, one groove 16 being located between every two adjacent bores in each row. A rebate 6 is again provided around the edge of the plate 1. This rebate and all the recesses again have the same depth and can readily be formed by means of a side-milling cutter. Outside the two rows of bores 2, further raised portions 17 are left on the front surface of the base plate 1. These portions, however, can also be removed by milling if a maximum supporting surface for a capping device is to be obtained, as in the embodiment shown in Fig. 10. The further steps in the method of manufacturing the jet nozzle plate shown in Fig. 11 are identical to those already described with reference to Figs. 4, 5, 6 and 7 so that all the raised portions on the front surface of the base plate of Fig. 11 are thereby converted into troughs in the finished jet nozzle plate, and all the recesses and the rebate in the front surfaces of the base plate of Fig. 11 are converted into lands on the finished plate.
- In this embodiment, the base plate 1 is formed by a raised part of a larger plate 18 in order to facilitate the attachment of the very small jet nozzle plate to the ink-jet printing head. For example, this can be effected by means of screws, for which purpose corresponding holes 19 are provided in the plate 18.
- The embodiment of Fig. 12 comprises a base plate similar to that of Fig. 11 but in which the intersecting grooves in the front side of the plate leave raised portions of hexagonal shape surrounding the bores 2. To this end, again three straight grooves 13, 14 and 15 are provided which extent parallel to the two rows of bores 2. Also provided are a plurality of parallel grooves 20 which intersect the grooves 13, 14 and 15 and extend obliquely of the rows of bores 2 in one direction, and a further plurality of parallel grooves 21 which intersect the grooves 13, 14 and 15 and the grooves 20 and which extend obliquely of the rows of bores in the opposite direction, each of the grooves 20 and 21 passing between two adjacent bores in one row and two adjacent bores in the other row. The grooves can again be readily formed by means of side-milling cutters. After completion of the method in the described manner, a jet nozzle plate is obtained whose jet nozzles are formed by projecting tubes each surrounded by a trough which has a hexagonal periphery defined by lands on the front surface of the plate, so that the individual jet nozzles are again uniformly centrically situated in a free manner.
- Obviously, further modifications of the described embodiments are feasible, for example, in the choice of the materials used for the

manufacture of the base plate and for the etch-resistant layer to be provided thereon. For example, the base plate may alternatively be made of bronze or a chemically etchable synthetic material, or the etch-resistant layer may be chromium.

#### CLAIMS

1. A method of manufacturing a jet nozzle plate for an ink-jet printing head, which plate comprises  
10 a jet nozzle having a given internal diameter, wherein a base plate from which the jet nozzle plate is to be formed and which is made of a chemically etchable material is first provided with a bore which extends through the base plate and  
15 of which at least a portion that opens out of one side of the plate is cylindrical and has a diameter larger than the desired internal diameter of the ultimate jet nozzle, material is then removed from said one side of the base plate by milling so as to leave on said side of the base plate a portion which adjacently surrounds the bore and is raised with respect to the adjoining portion of said side of the base plate, the whole of the base plate including the wall of the bore is subsequently  
20 covered with a layer of etch-resistant material which is chemically deposited on the plate to a thickness equal to half the difference between the diameter of said cylindrical portion of the bore and the desired internal diameter of the ultimate jet  
25 nozzle, after which the etch-resistant layer is removed from at least the top of the raised portion on said one side of the base plate by grinding in a plane perpendicular to the axis of the bore to a depth which at least equals the thickness of said  
30 layer but which is smaller than the sum of the thickness of the layer and the depth to which material was removed from said one side of the base plate by milling, and finally material of the base plate surrounding the bore and exposed by  
35 the grinding is removed by etching to leave the etch-resistant material which was deposited on the wall of said cylindrical portion of the bore projecting as a cylindrical tube from said one side of the base plate to form the jet nozzle, the tube being surrounded by a trough formed in said one side of the base plate by the etching.  
40 2. A method as claimed in Claim 1, wherein the grinding is continued until the etch-resistant layer  
45

- 50 on that part of said one side of the base plate from which material was removed by milling has been partially ground down.  
3. A method as claimed in Claim 1 or 2, wherein the removal of material from said one side of the base plate by milling forms an annular recess in said side of the plate, which recess surrounds and is spaced from the bore in the base plate.  
55 4. A method as claimed in Claim 1 or 2, wherein the removal of material from said one side of the base plate by milling is effected by milling straight grooves in said side of the plate, the grooves intersecting one another so as to form around the bore in the base plate and spaced therefrom a recess in the form of a channel of  
60 polygonal shape in said side of the base plate.  
5. A method as claimed in Claim 2, or Claim 3 or 4, when read as appendant to Claim 2, wherein the removal of material from said one side of the base plate by milling is carried out to a depth  
70 greater than the thickness of the etch-resistant layer subsequently deposited on the base plate.  
6. A method as claimed in Claim 3 or 4, or Claim 5 when read as appendant to Claim 3 or 4, wherein a rebate is milled in said one side of the  
75 base plate around the edge thereof prior to the deposition of the layer of etch-resistant material, the rebate having the same depth as the recess surrounding the bore in the base plate.  
7. A method as claimed in any of the preceding  
80 8. A method as claimed in Claim 1 or 2, or Claim 5 when read as appendant to Claim 1 or 2, wherein material is removed by milling from the whole of said one side of the base plate except for the portion surrounding the bore.  
9. A method of manufacturing a jet nozzle plate, substantially as herein described with reference to Figs. 1 to 7 or any of Figs. 8 to 12.  
95 12. A jet nozzle plate manufactured by the method claimed in any of Claims 1 to 9.